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Use of Robotics During Laparoscopic Gastric Bypass for Morbid Obesity

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ABSTRACT

To evaluate the theoretical increased precision offered by utilization of the robotic instrument, we attempted to determine whether incorporation of its use into traditional laparoscopic gastric bypass would duplicate or improve the success of the operation without increasing complications. The Roux-en-Y gastric bypass is the most commonly performed procedure for morbid obesity in the United States. We performed 120 gastric bypass procedures with traditional laparoscopy during a 30-month period. We began introducing the da Vinci Robotic Surgical System into our laparoscopic gastric bypass procedure and evaluated its effectiveness.

Key Words: Laparoscopic gastric bypass, Morbid obesity, Robotics.

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INTRODUCTION

With the increasing rate of morbid obesity in the United States, surgical methods to evaluate weight loss are being increasingly utilized. Despite the recent approval in the United States of the Lap-Band device, the Roux-en-Y gastric bypass remains the surgical procedure of choice for morbid obesity. This minimally invasive laparoscopic approach to Roux-en-Y gastric bypass is becoming increasingly popular. Although the complication rate has decreased and morbidity and mortality have now approached that of the open technique, a risk still remains of gastrojejunal leakage and subsequent death of approximately 3% and 1%, respectively.

After performing 120 gastric bypass procedures with traditional laparoscopy, we incorporated robotics into the performance of laparoscopic gastric bypass procedures. Our aim was to take advantage of the precision of the robotic instruments to duplicate or improve upon the results obtained with traditional laparoscopic gastric bypass methods.

METHODS

Forty-one cases of laparoscopic gastric bypass were performed with robotics from August 2001 until February 2002. The robotic instrument used was the da Vinci Robotic Surgical System (Intuitive, Mountain View, CA). We sought to calculate patient demographics **(Table 1)**, total operating time, setup time for the robotic system, and operating time for the robotic system.

RESULTS

Forty-one patients underwent a primary laparoscopic gastric bypass with robotics during a 7-month period. Patient demographics, including accompanying comorbid conditions, are listed in **Tables 1 and 2.** The patient population was predominately female (37/4), which is consistent with other series. The average body mass index (BMI) of 52.8 shows that the procedure was not limited to those patients more likely to have a routine surgical and postoperative course.

The average time needed to incorporate the robotic sys-

Table 1.
Patient Demographics

Number of Cases	41
Average Age (years)	42.5
Sex (male/female)	4/37
Average Weights (kgs)	146.2
Average Body Mass Index (kg/m^2)	52.8
Average Length of Hospital Stay (days)	4.6

Table 2.
Comorbid Conditions

Asthma	5
Sleep Apnea	10
High Cholesterol	7
Arthritis	10
Diabetes Mellitus	10
Hypertension	15
Gastroesophageal Reflux	3

tem into the operative field averaged 14 minutes, but revealed a dramatic learning curve. Three of the initial 9 cases required ≥30 minutes to introduce the robot, and 5 of the initial 9 cases required >20 minutes for setup. However, 1 of the final 32 cases required ≥20 minutes to set up **(Table 3)**.

The robotic work time also required a learning curve, although it was longer than the learning curve for the robotic setup time. The average time for the robotic system to perform the gastrojejunostomy was 62 minutes; the last 6 cases took <60 minutes to perform, and the last 3 took <40 minutes.

In comparison with the standard laparoscopic gastric bypass, which we performed, the use of the robot extended our operative time. The patients in whom the laparoscopic gastric bypass was performed were similar to the patients who had the procedure done with the robot. The average BMI in the laparoscopic group was 54, and females predominated. The co-morbidities were also similar. The average length of time for the laparoscopic procedure was 174 minutes, which is less than the operative time with the robot. The gastrojejunal anastomosis was performed with an average time of 21 minutes, which again is less than that with the robot. The incidence of gastrojejunal leak with the robot was <3%, which is the same as that with the laparoscopic approach.

Table 3.
Operating Times (Minutes)

Laparoscopic Portion	149
Robot Set up Time	14
Robotic Portion	62
Robot Takedown Time	7
Total Procedure Time	289

DISCUSSION

Despite other surgical procedures for weight loss, the Roux-en-Y gastric bypass remains the surgical procedure of choice in the United States for the treatment of morbid obesity. It is obvious, therefore, that numerous attempts are being made by many surgeons to improve upon the technique of the procedure. The most obvious of these is the performance of the procedure in a laparoscopic fashion, which leads to decreased length of stay, easier patient recuperation, earlier return to work and activities of daily living, and improved cosmesis.

The limiting factor in the performance of the Roux-en-Y gastric bypass is the construction of the gastrojejunostomy. This is even more magnified with the laparoscopic approach in which the usual 2-layered hand-sewn anastomosis performed during open gastric bypass is extremely difficult to perform. Intracorporeal knot-tying, although essential in advanced laparoscopic techniques, is extremely difficult to learn, increases the time of the operation, and could lead to catastrophic consequences if not performed properly.

This is especially true during performance of the gastrojejunostomy during Roux-en-Y gastric bypass where the size and body habitus of the patient could make the performance of the gastrojejunostomy difficult or impossible with intracorporeal tying. The difficulty in performing intracorporeal tying has been described elsewhere.[1,2] Devices to assist the surgeon in knot tying have been developed, and although they have decreased the time needed to perform intracorporeal tying, they have the limitations of being less accurate, having limited suture type available, and limitations in the thickness of the tissues being sutured to be successful.

The reason for the difficulty in performing intracorporeal suturing is many-fold:[1] The movement of the instruments is limited by trocars fixed into the abdominal wall. This is made worse in the morbidly obese patient where only a

small portion of the laparoscopic instrument is outside the abdominal wall, with most being in the deepened subcutaneous tissue, fat layer, and abdominal cavity. With such a small part of the instrument present externally, a small motion by the operator leads to exaggerated movements inside the abdominal cavity, thereby decreasing the precision of intracorporeal tying.[2] The instruments are long and rigid and decrease the precision, dexterity, and tactile sensation of the operator.[3] Very limited degrees of freedom exist in the abdominal cavity for suturing with the present generation of laparoscopic instruments.

After performing laboratory procedures and intracorporeal suturing on pigs with the da Vinci Robotic Surgical System, we decided to attempt to incorporate the robotic technology into the performance of the gastrojejunostomy with robotic assistance during laparoscopic gastric bypass.[3] The improved degrees of freedom provided by the da Vinci Robotic Surgical System enabled our surgical team to perform the gastrojejunostomy with dexterity that more closely mimics that achievable during open gastric bypass than other intracorporeal techniques. The robotic arms and hands provide 6 degrees of motion for suturing, a vast improvement from the 4 degrees of freedom provided by conventional rigid laparoscopic instruments during intracorporeal tying.

We also found that the increased magnification and 3-dimensional view afforded us improved visibility to achieve more precision in the placement of sutures during performance of the gastrojejunal anastomosis.[6] In fact, the team of 3 attending surgeons felt that the view of the suture placement was better when compared with that in both conventional laparoscopy and open performance of the gastrojejunostomy. Another improved feature offered by robotics is the improved ergonomics afforded to the surgeon during the procedure. Advanced laparoscopic procedures can often place the surgeon in uncomfortable and awkward positions with the body, arms, and hand, which can lead to frustration, increased tiredness, and possible risk of operative misadventure.[5] Working at the surgeon console, sitting a short distance from the operative table, gives the surgeon an increased feeling of comfort, stamina, and control. We have successfully incorporated the use of robotics into the performance of laparoscopic gastric bypass. The advantages, as outlined above, have been previously noted in other surgical specialties currently using robotic surgery.[4] We will attempt to expand the use of robotics in the performance of laparoscopic gastric bypass by not limiting its use to only the performance of the gastrojejunostomy, but by incorporating a larger portion of the procedures to be done robotically.

The improved technology provided by present-day robotic systems is both fascinating and exciting. Similar to the initial introduction of laparoscopic cholecystectomy, there will be some reluctance before robotic technology is universally performed in laparoscopic procedures. Once the technology improves and these initial robotic devices are replaced by systems more portable, less cumbersome, and faster to incorporate into the operative field, the increased technology afforded by the robotic system will ensure that it will be used by surgeons interested in remaining on the cutting edge of surgical advances.

CONCLUSION

The use of the robot in performance of gastric bypass did provide enhanced precision in performance of the gastrojejunal anastomosis, but it produced comparable complication results. The use of the robot offers no advantage in performing laparoscopic gastric bypass for morbid obesity. It increases both the cost of the operation and the time of the operation as well. Until the robot is cheaper and more convenient to use we cannot recommend its use.

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